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WAVERLY DAM (ME 00111.. (U) CORPS OF ENGINEERS WALTHAM
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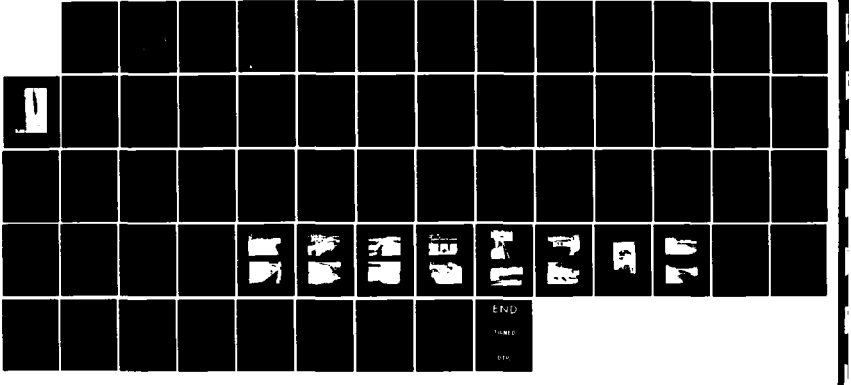
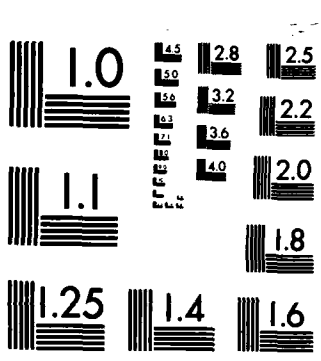
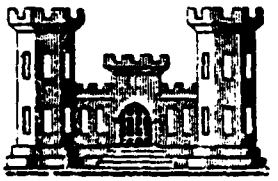




KENNEBEC RIVER BASIN
PITTSFIELD, MAINE

WAVERLY DAM
ME 00111

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Kennebec River Basin
Pittsfield Maine
Sebasticook River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The overall length of the dam is about 284 ft. with an associated height of 20 ft. In the case of failure of the dam it could cause the possible loss of a few lives. The dam is in fair condition. It is intermediate in size with a hazard potential of significant.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

SEP 1 1981

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Waverly Dam (ME-00111) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Agriculture and to the owner, Town of Pittsfield, Maine. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Agriculture for your cooperation in in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

KENNEBEC RIVER BASIN
PITTSFIELD, MAINE

WAVERLY DAM
ME 00111

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1981

NATIONAL DAM INSPECTION PROGRAM
PHASE I INVESTIGATION REPORT

Identification No.:	ME 00111
Name of Dam:	Waverly
Town:	Pittsfield
County and State:	Somerset, Maine
Stream:	Sebasticook River
Date of Site Visit:	6 November 1980

BRIEF ASSESSMENT

Waverly Dam is a masonry gravity structure consisting of a broad crested spillway and regulating outlets located at either end of the spillway. The overall length of the dam is approximately 284 ft. with an associated height of 20 ft. The storage at top of dam is estimated to be 7,140 acre-ft. The structure is apparently founded on bedrock and maintains an upstream pool which is used by the Town of Pittsfield for recreational purposes.

Due to the possible loss of a few lives, in the event the dam were to fail, Waverly Dam has been determined to have a "significant" hazard potential classification in accordance with Corps of Engineers guidelines.

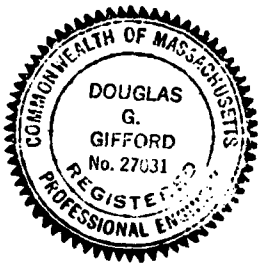
The dam is in fair condition, based on a visual examination of the structure. Although some deficiences were noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or other conditions which would warrant urgent remedial action.

Based on the "intermediate" size and "significant" hazard potential classifications in accordance with Corps of Engineers guidelines, the adopted test flood for this dam is 1/2 the Probable Maximum Flood (1/2 PMF). Hydraulic analyses indicate that the test flood outflow of 15,000 cfs would overtop the dam by about 1.6 ft. With the water level at the top of dam, the ungated spillway capacity is approximately 9,640 cfs which is 64 percent of the test flood.

The Town of Pittsfield should engage a registered professional engineer qualified in the design and construction of dams to investigate the seepage at the left abutment and spillway left training wall, and perform a hydrologic/hydraulic investigation for the facility, as outlined in Section 7.2. Any necessary modifications resulting from the investigations, and remedial measures, including repointing and repair of spalled and cracked masonry, removal of vegetation growing out of forebay masonry sections, and inspect the facility during a period of low flow, as outlined in Section 7.3, should be implemented by the Owner within one year after receipt of this report. The Owner should also prepare a formal operations and maintenance manual for the dam and establish an emergency preparedness plan and downstream warning system.

HALEY & ALDRICH, INC.
by:

Douglas G. Gifford
Vice President



This Phase I Inspection Report on Waverly Dam (ME-00111) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be

needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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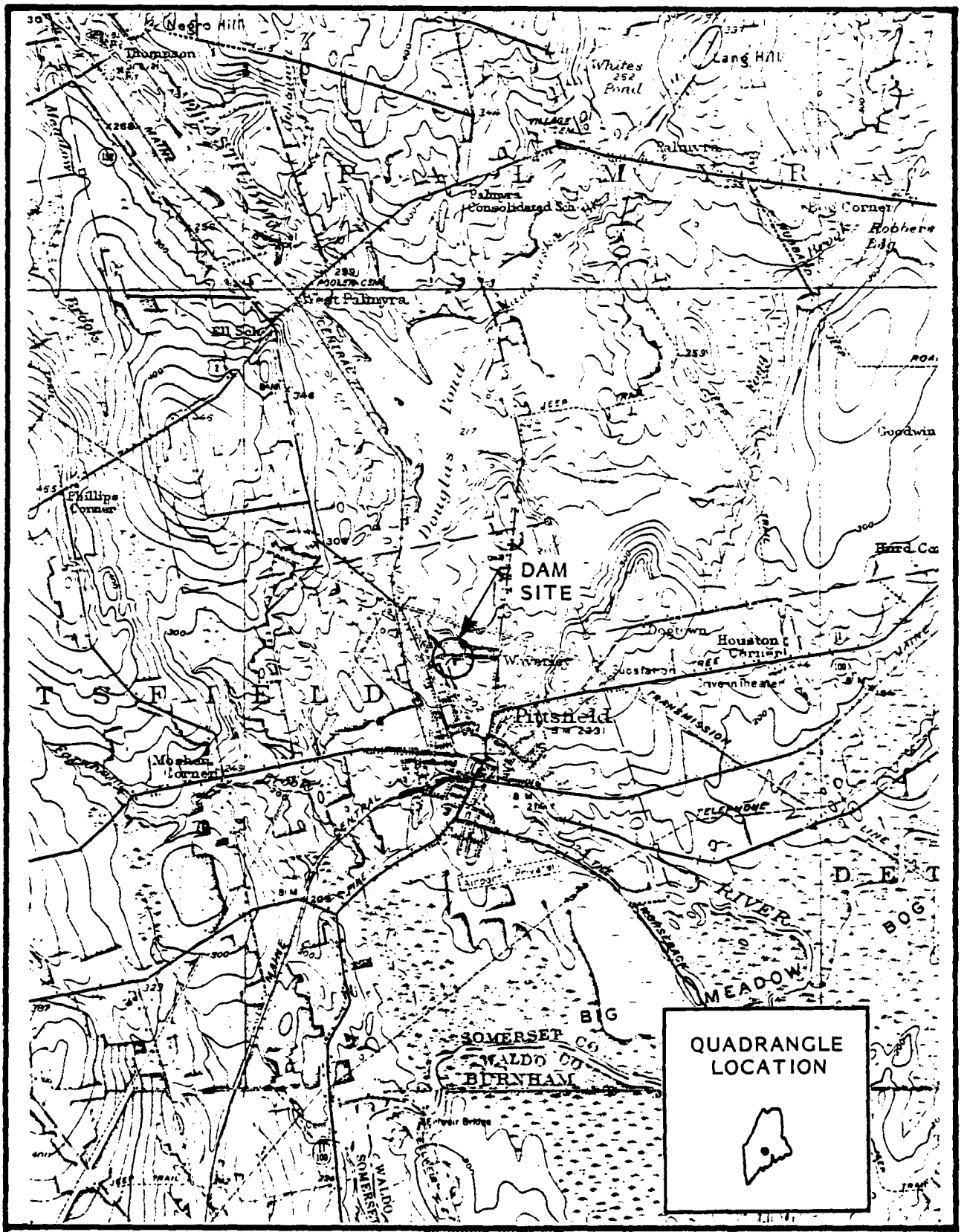

FILE NO. 4454 A49

DAM: Waverly

IDENTIFICATION NO. ME 00111

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LOCATION MAP

U.S.G.S. QUADRANGLE

PITTSFIELD, ME

APPROX. SCALE: 1"= 1 MILE

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

WAVERLY DAM
ME 00111

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of New Hampshire and Maine. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 31 October 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW33-80-C-0009 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to intiate effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Waverly Dam, also known as Upper Dam, is located on the Sebasticook River in the Town of Pittsfield, Maine, Somerset County, as shown on the Location Map, page vii. The latitude and longitude of the dam site are N44°47.7' and W69°23.2', respectively. Flow is conveyed from the dam by the Sebasticook River to the Kennebec River.

b. Description of Dam and Appurtenances. Waverly Dam is a masonry gravity structure consisting of a broad crested spillway and regulating outlets located at either end of the spillway. Both of the abutments are earth fill retained by masonry. Overall length of the dam is approximately 284 ft. with an associated height of 20 ft. Top of dam, taken as the top of the spillway right training wall, is at El. 220.1. The structure is apparently founded on bedrock.

The spillway is of a more recent construction than other portions of the dam. The spillway weir is about 195-ft. long and 3-ft. wide at the crest. Side slopes are 2 horizontal to 1 vertical upstream and 3 horizontal to 4 vertical downstream.

The spillway left training wall abuts an intake structure, with three wooden slide gates, that was previously used to regulate flow into a stone masonry forebay. Along the axis of the dam the intake structure has an overall length of approximately 48 ft. A generating facility, that was located immediately downstream of the intake structure and forebay, is now in ruins.

The outlet works consists of two 5-ft. wide stoplog bays located at the right end of the spillway. Adjacent and to the right of the outlet works are two short 6-ft. diameter penstocks with slide gates. From the right end of the spillway to the right abutment is 41 ft. The alignment of this section is coincident with the alignment of the spillway.

Upstream of the left abutment there is a 66-ft. long masonry retaining wall skewed left and upstream to the alignment of the dam. This wall extends from the dam to the wingwall of a roadway bridge, Waverly Street, that crosses the upstream pool. The wall consists of both concrete and stone masonry segments. There is no similar wall

at the right abutment. However, the outlet works structure at the right abutment has 2.5-ft. wide training walls between bays and an enlarged 5-ft. wide training wall at the right end of the spillway. A building that previously housed a generating facility, located immediately downstream of the right abutment, is now utilized as a single family dwelling.

c. Size Classification. The storage to the top of Waverly Dam is estimated to be 7,140 acre-ft., and the corresponding hydraulic height of the dam is approximately 20 ft. Storage of from 1,000 to 50,000 acre-ft. and/or a height of from 40 to 100 ft. classifies a dam in the "intermediate" size category, according to the guidelines established by the Corps of Engineers. Although the height of this dam is much less than 40 ft., it is classified as an "intermediate" size dam by virtue of its storage capacity.

d. Hazard Classification. Dam failure analysis computations in Appendix D which are based on "Guidance for Estimating Downstream Dam Failure Hydrographs" demonstrate why Waverly Dam has been classified as having a "significant" hazard potential. Failure of the dam could result in the loss of a few lives, and increase pre-failure flooding depths by about 2.5 ft. which would increase property damages.

e. Ownership. The name, address and phone number of the current owner are:

Town of Pittsfield
P.O. Box R
Pittsfield, Maine 04967
Phone (207) 487-3136

All correspondence should be addressed to the attention of the Town Manager.

f. Operator. Mr. Richard A. Nadeau, Public Works Director, has been responsible for the operation, maintenance and safety of the dam since 1976. He can be reached at the address and phone number given above.

g. Purpose of Dam. The present function of Waverly Dam is in maintaining an upstream pool which is used by the Town of Pittsfield for recreational purposes. The facility was previously used for power generation.

h. Design and Construction History. There are no design or construction records available to document when, how and by whom the original dam was built. The spillway was reportedly rebuilt in 1970, but no records of this work could be found.

i. Normal Operational Procedures. There are no formal written procedures for the operation of Waverly Dam. The spillway weir has a fixed crest with no provisions for flashboards. The gated and stoplogged outlets are not operated. It is understood that the dam is periodically inspected by the Operator and that repairs are made on the basis of need as determined by the Owner.

1.3 Pertinent Data

The Operator of the dam reported a spillway crest elevation of 214.5 USGS. By comparison with information contained on the USGS Pittsfield, Maine, Quadrangle Map, it appears reasonable to assume the reported elevation is correct. Therefore, the elevations presented in this report are based on National Geodetic Vertical Datum assuming the spillway crest at El. 214.5.

a. Drainage Area. The 290 sq. mi. drainage area tributary to the dam site consists of sparsely developed rolling terrain which is primarily drained by the Sebasticook River. In addition to numerous small ponds, the upstream watershed contains Douglas and Indian Ponds and Great Moose Lake which have a combined surface area of about 9 sq. mi. Additionally, a large marsh area is located in the Town of Cambridge, Maine, having a surface area of about 5 sq. mi. upstream of Route 152.

b. Discharge at Dam Site

1. Outlet works.....	Approx. 500 cfs with upstream pool at spillway crest elevation
2. Maximum known flood at dam site.....	Unknown
3. Ungated spillway capacity at test flood pool elevation.....	9,640 cfs at El. 220.0

4.	Ungated spillway capacity at top of dam...	14,300 cfs at El. 221.7
5.	Gated spillway capacity at normal pool elevation.....	Not applicable
6.	Gated spillway capacity at test flood pool elevation.....	Not applicable
7.	Total spillway capacity at test flood pool elevation.....	14,300 cfs at El. 221.7
8.	Total project discharge at test flood pool elevation.....	15,000 cfs at El. 221.7

c. Elevation (ft. above NGVD)

1.	Streambed at centerline of dam.....	200.0
2.	Maximum tailwater....	Unknown
3.	Upstream portal invert diversion tunnel	Not applicable
4.	Normal pool.....	214.5
5.	Full flood control pool.....	Not applicable
6.	Spillway crest.....	214.5
7.	Design surcharge - original design.....	Unknown
8.	Top of dam.....	220.1
9.	Test flood surcharge	221.7

d. Length of Reservoir (mi. estimated)

1.	Normal pool.....	2.4
2.	Flood control pool...	Not applicable
3.	Spillway crest pool..	2.4
4.	Top of dam.....	3.1
5.	Test flood pool.....	3.3

e. Storage (acre-ft.)

1.	Normal pool.....	2,800
2.	Flood control pool...	Not applicable
3.	Spillway crest pool..	2,800
4.	Top of dam.....	7,140
5.	Test flood pool.....	8,380

f. Reservoir Surfaces (acres)

1.	Normal pool.....	560
2.	Flood control pool...	Not applicable
3.	Spillway crest pool..	560
4.	Top of dam.....	1,000
5.	Test flood pool.....	1,125

g. Dam

1.	Type.....	Gravity; masonry with earth filled abutments at either end
2.	Crest length.....	284 ft. (approximately)
3.	Height.....	20.1 ft.
4.	Top width.....	See i. Spillway
5.	Side slopes.....	See i. Spillway
6.	Zoning.....	Unknown
7.	Impervious core.....	Not applicable
8.	Cutoff.....	Unknown
9.	Grout curtain.....	Unknown
10.	Other.....	Spillway rebuilt in 1970

h. Diversion and Regulating Tunnel..... Not applicable

i. Spillway

1.	Type.....	3-ft. wide broad crested concrete weir
2.	Length of weir.....	195 ft. (est.)
3.	Crest elevation.....	214.5
4.	Gates.....	None
5.	U/S face.....	Concrete at approximately 2H to 1V extending into U/S pool
6.	D/S face.....	Concrete at approximately 3H to 4V to channel bed of Sebasticook River

j. Regulating Outlets

		Left end of dam	
1.	Description.....	Three wooden slide gates	
2.	Size.....	Gate chambers 3.5-ft. wide x 8.0-ft. high	
3.	Invert.....	El. 207.3	
4.	Control mechanism....	Manually operated with lift mechanism located at top of structure, El. 221.3	
		Right end of dam	
1.	Description.....	Two stoplog bays and two truncated steel penstocks each with wooden slide gates at upstream end	
		Stoplog bays	**Penstock gates**
2.	Size.....	5-ft. wide x 8.75-ft. high	8-ft. wide x 8.25-ft. high
3.	Invert.....	El. 207.0	El. 209.0
4.	Control Mechanism.....	Manually operated	Manually operated with lift mechanism located at top of structure El. 220.1

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam were located and none are believed to exist.

2.2 Construction Data

No as-built data or records of the construction of the dam or the reconstruction of the spillway were located and none are believed to exist.

2.3 Operation Data

No operational data for the facility were located.

2.4 Evaluation of Data

a. Availability. A list of the data available for use in preparing this report is included on page B-1.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Waverly Dam. This Phase I assessment was therefore based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. In general, the available data located were not applicable to an engineering evaluation of the dam.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of the Waverly Dam was conducted on 6 November 1980. The upstream water surface elevation was about 0.6 ft. above the spillway crest that day.

In general, the project was found to be in fair condition. Some deficiencies which require correction were noted.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. Waverly Dam, the spillway, outlet structures and walls retaining the earth fill, appeared to be in fair condition, Photo No. 1. The upstream side of the spillway was free of debris. The concrete placed during the reconstruction of the spillway, visible at the left spillway training wall only, Photo No. 7, was in satisfactory condition. The horizontal and longitudinal alignments of the spillway were good, Photo Nos. 10 and 11, respectively. The concrete at both abutments, was spalled, cracked and had visible efflorescence, but appeared structurally sound overall, Photo Nos. 4 and 13.

No significant settlements, displacements or distressed masonry were observed during the site examination. The filled upstream pool, and flow over the weir, precluded a close examination of the upstream face of the dam and the spillway, Photo No. 16.

c. Appurtenant Structures. The intake structure located at the left end of the dam was in fair condition, Photo No. 2. The gate lift mechanisms had been partially dismantled and were not operable. The concrete supports for the lift mechanisms were cracked and spalled as was the top slab of the intake structure, particularly at the gate slots. In addition, the upstream and downstream

concrete faces of the intake structure were spalled, Photo Nos. 4 and 8, respectively, and had reinforcing steel visible.

The downstream side of the construction joint formed by the spillway left training wall and right side of the intake structure was wet with seepage, Photo No. 7. The water was clear but of an insufficient flow rate to be estimated. Seepage and rust staining were present at the interior side of the left forebay wall, where the forebay joins the intake structure, Photo No. 9. The flow rate here was also low and due to the location of the condition close examination was not feasible.

The stone masonry of the forebay was in fair condition with some loose joints and dislodged blocks, Photos No. 3 and 6. Trees and brush were growing from the forebay walls, Photo No. 5, with associated deterioration of the masonry. The forebay endwall, which houses two 8.7-ft. diameter steel penstock sections, Photo No. 3, was in fair condition.

Beyond the forebay the abandoned generating facility was separated and protected from the downstream river channel by a concrete training wall, Photo No. 5. Due to the location of the wall, it was not considered pertinent to the safety of the dam.

The two stoplog bays and two penstocks, located at the right side of the dam, were in good condition, Photo No. 12. The gate lift mechanisms were partially dismantled and not operable. Flow through one of the penstocks, Photo No. 13, indicated leakage through the corresponding slide gate. The gate chamber training walls were cracked at the top, Photo No. 14, where steel members were embedded in the concrete. These steel members supported walkway gratings at some previous time.

d. Reservoir Area. The banks of the upstream reservoir are moderately sloped and undeveloped, Photo No. 15. The pond has an elongated shape measuring about 2.4-mi. long by about 0.5-mi. wide and a recreational pool surface area of about 560 acres.

e. Downstream Channel. The Sebasticook River, Photo No. 16, flows from the dam through the Town of Pittsfield, Maine. The Pioneer Dam is located on the river near the center of Pittsfield about 3,500-ft. downstream of Waverly Dam. Existing residential and commercial development along the downstream channel have sill elevations about 6 ft. above the normal channel water surface.

3.2 Evaluation

Based on the visual examination conducted on 6 November 1980, Waverly Dam is considered to be in fair condition. However, the remedial measures outlined in Section 7.3 should be implemented to correct the noted deficiencies in the masonry at both ends of the dam, and vegetation in the forebay masonry walls located at the left end of the dam. In addition, repairs should be made to stop leakage through the regulating outlets to maintain the water level of the normal pool during periods of low flow.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. There are no formal procedures for the operation of the dam.

b. Description of Any Warning System in Effect. There is no warning system or emergency preparedness plan in effect for this facility.

4.2 Maintenance Procedures

a. General. There are no established formal procedures or manuals for inspection and maintenance of the dam. Remedial measures pertaining to the dam are performed on an as needed basis as determined by the Owner.

b. Operating Facilities. The spillway has no provisions for flashboards. Gate lift mechanisms were not operational at the time of the site examination. There is no formal plan to maintain the outlet works and controls. Though no attempt was made to remove the outlet works stoplogs during the site examination, no conditions were observed that would hinder their removal during periods of normal flow. However, the hazard associated with the operation of the stoplogs during periods of high flow may make their removal impractical.

4.3 Evaluation

The Owner should prepare an operations and maintenance manual for the dam. The manual should delinate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. An annual observation and maintenance program should be established to examine the dam, control vegetation growth and maintain slopes, walls and channels. A formal procedure should be established to ensure that the stoplogs can be readily removed.

Since failure of the dam could potentially cause loss of life and property damage downstream, the Owner should also prepare and implement a formal emergency preparedness plan and downstream warning system.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Waverly Dam is a run-of-the-river dam located on the Sebasticook River in the Town of Pittsfield, Maine. The center line crest length of the dam is approximately 284 ft. which includes a 195-ft. long broad crested concrete spillway weir. The top of the dam is El. 220.1 at the spillway right training wall, El. 221.3 at the left, and the spillway crest is at El. 214.5. The outlet works consist of two 5-ft. wide stoplog bays located at the right end of the spillway. Additionally, there are five gated outlets which were once used in conjunction with power generation. The 290.0 sq. mi. drainage area is drained by several tributaries and incorporates three major bodies of water which have a combined surface area of about 9 sq. mi.

5.2 Design Data

There is no hydrologic/hydraulic design data available for the dam.

5.3 Experience Data

No records of historical floods at the dam site were located.

5.4 Test Flood Analysis

Based on the Corps of Engineers Guidelines, the recommended test flood range for the size "intermediate" and hazard potential "significant" is the 1/2 PMF to full PMF (Probable Maximum Flood). The 1/2 PMF was adopted as the test flood for this facility because the project is at the low end of the "intermediate" size classification category. In order to account for the available storage in the upstream watershed, the test flood was estimated by considering preliminary analysis by the Corps of Engineers for a flood protection study of the Sebasticook River upstream of Waverly Dam in the Town of Hartland, Maine. The drainage area at this location is about 235 sq. mi. and is downstream of Great Moose Lake. The estimated Standard Project Flood (SPF) is reported to be 8,000 cfs at that location. Assuming a peak PMF inflow rate of 250 csm for the intervening 55 sq. mi. drainage area the resulting test flood at the dam site would be about 15,000 cfs.

The spillway capacity with the upstream pool at top of dam (El. 220.1) is estimated to be 9,640 cfs or about 64 percent of the test flood. The test flood would overtop the dam by about 1.6 ft. Consequently, Waverly Dam is considered hydraulically unable to pass the test flood under existing conditions.

5.5 Dam Failure Analysis

Based on the Corps of Engineers Guidelines for estimating dam failure hydrographs, and assuming that 40 percent of the spillway section fails (approximately 178 ft.) with the upstream pool at top of dam, the combined peak failure outflow is estimated to be about 17,500 cfs. In the event of a dam failure, the house located at the right abutment of the dam could potentially collapse as its foundation forms the right downstream training wall.

The mill complex located to the left of the dam would probably experience flooding prior to a dam failure. Any additional flooding resulting from a failure would not be expected to increase the potential for loss of life. Similarly, existing development along the Sebasticook River would also experience minor flooding from the project discharge occurring prior to failure. It is estimated that a dam failure could increase flooding depths by about 2.5 ft. which would increase property damages but not substantially increase the potential for loss of life.

The potential loss of life resulting from a dam failure is a few and the dam is accordingly classified in the "significant" hazard category.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

Cracking and deterioration of the masonry retaining wall located upstream of the left abutment were noted and warrant attention. However, no reason was found to question the overall structural stability of the wall as there was no visual evidence of significant settlement or lateral movement. The seepage condition noted at the upstream end of the left interior forebay wall, though considered minor, warrants attention. The structural stability of the forebay wall appeared satisfactory.

The spillway weir was obscured by flowing water during the site examination preventing close examination. Since there was no evidence of major settlement or lateral movement, no reason was found to question the stability of the spillway.

6.2 Design and Construction Data

No design plans or construction data were located for Waverly Dam.

6.3 Post-Construction Changes

The Operator reported that the spillway was rebuilt in 1970 but no records of the work could be located.

6.4 Seismic Stability

Waverly Dam is located in a Seismic Zone 1 and, in accordance with Corps of Engineers' guidelines, does not warrant further seismic analysis at this time.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Waverly Dam indicated the facility was in fair condition. Although there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, deficiences in the form of leakage through the slide gates, seepage at the left abutment and spillway left training wall, deterioration and cracking of the masonry and vegetation growing from the forebay walls were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is not capable of passing the test flood, which for this structure is the 1/2 PMF. The test flood flow of 15,000 cfs would overtop the dam by about 1.6 ft. With the water level at the top of dam, the spillway capacity is about 9,640 cfs, which is 64 percent of the test flood flow.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally, the information obtained was adequate for the purpose of a Phase I assessment.

c. Urgency. The recommendations for additional investigations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

7.2 Recommendations

It is recommended that the Owner engage a registered professional engineer qualified in the design and construction of dams to undertake the following investigations:

1. Investigate the seepage flow at the left abutment, where the concrete intake structure joins the forebay wall, to determine its effect on the stability of the left abutment. Also the seepage at the construction joint formed by the spillway left training wall and the right side of the intake structure should be investigated to determine the present and long-term effects of the condition.

2. Perform a detailed hydrologic/hydraulic investigation to determine the appropriate test flood for the facility, and assess further the potential of overtopping the dam and the need for and means to increase project discharge capacity. As a means to increase project discharge capacity, consideration should be given to restoring the regulating outlets, at both ends of the dam, to operational condition.

The Owner should then implement corrective measures on the basis of these engineering investigations.

7.3 Remedial Measures

Although the dam is generally in fair condition, it is considered important that the following items be accomplished:

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Repoint the spalled and cracked areas of the upstream retaining wall and intake structure at the left end of the dam.

2. Remove the tree and brush growth from the forebay and all other masonry walls.

3. Repair the cracks in the concrete of the outlet works training walls at the right end of the dam.

4. Prepare an operations and maintenance manual for the dam. The manual should include provisions for annual technical inspection by a qualified registered engineer and for round-the-clock surveillance of the dam during periods of high project discharge. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility.

The next technical inspection should preferably be scheduled during a period of low flow to allow a more detailed inspection of the spillway.

5. Develop a written emergency preparedness plan and warning system to be used in the event of emergency conditions. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A - INSPECTION CHECK LIST

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

Dam: Waverly Dam

Date: 6 November 1980

Time: 1400-1700 hrs.

Weather: Overcast - temperature 35-40°F

Water Surface Elevation Upstream: Approximately 0.6 ft. above spillway crest

Stream Flow: Approx. 270 cfs

Inspection Party:

Douglas G. Gifford	-	Soils/Geology
Charles R. Nickerson Haley & Aldrich, Inc.		
Joseph E. Downing	-	Hydraulic/Hydrologic
Francis E. Luttazi Camp, Dresser & McKee, Inc.	-	Structural/Mechanical

Present During Inspection:

Richard Nadeau - Pittsfield, ME Department of Public Works

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Waverly Dam DATE: 6 Nov. 80

AREA EVALUATED	CONDITION
OUTLET WORKS - LEFT SIDE	NOTE: Three wooden slide gates are located at the left side of the spillway, apparently constituting intakes for a forebay, located immediately downstream. The intake structure is concrete and a major portion of the forebay is stone masonry. A relatively low concrete training wall defined the D/S power channel, or tailrace, at its confluence with the main spillway discharge channel. Remains of a structure were noted in the channel just D/S of two 6.0-ft. long, 8.7-ft. diameter penstock sections located side by side within a stone masonry end wall spanning the forebay
a. Approach Channel	Not applicable. Intake gates front on U/S pool of Waverly Dam
b. Intake Structure	
Condition of Concrete	Poor at junction of left abutment wall with left stone masonry wall of forebay. General condition otherwise fair
Spalling	At location noted above, at U/S and D/S faces of intake structure, at top slab and supports for gate lift mechanisms, and at river channel side of right wall of structure
Visible Reinforcing	At top slab and D/S face
Cracking	Major pattern cracking at supports for gate lift mechanisms
Stoplogs and Slots	All three gate lift mechanisms were inoperable. Gates were in "down" position. Slot for gate at left of center in poor condition due to severe spalling
Any Seepage or Efflorescence	Both at middle and right gates. Minor seepage on side of right wall of structure at intersection with left spillway training wall

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Waverly Dam DATE: 6 Nov. 80

AREA EVALUATED	CONDITION
c. Power Channel	
General Condition	Good
Joints	Some loose joints noted in forebay stone masonry at inside faces of right, left and D/S end wall and at outside faces of right wall and D/S end wall. Ice action and/or dislodgement due to tree root action noted at spillway side of right wall near junction with U/S intake structure and again near junction with D/S concrete wall. Block dislodgement also observed at left wall just D/S of intake gate structure. Visible joints in concrete portion of right channel wall were spalled. This wall was inaccessible at time of inspection
Rust or Staining	At left channel wall just D/S of intake gate structure
Seepage	At same location as staining noted above
Erosion or Cavitation	Concrete portion of right channel wall is apparently undermined just D/S of the stone masonry end wall
Trees Overhanging Channel	Trees and brush were observed growing from both the right channel wall and the end wall
Channel Floor	Submerged. Build-up of earth and stone rubble observed U/S of end wall, and rubble remains of an apparent power facility observed D/S of end wall
OUTLET WORKS - RIGHT ABUTMENT	NOTE: Two stoplog bays and two wooden slide gates are located at the spillway right abutment and front on the U/S pool. The two gate mechanisms were partially dismantled and inoperable. The gates at the far right of the facility emptied into sections of 6 foot diameter steel penstocks. Penstocks were in good condition

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Waverly Dam DATE: 6 Nov. 80

AREA EVALUATED	CONDITION
General Condition of Concrete	Good
Rust or Staining	None observed
Erosion or Cavitation	Minor; at gate chamber side walls
Cracking	Major cracking observed at top of gate chambers where structural steel framing members are embedded into the concrete for the apparent purpose of supporting gate operators and/or walkway grating
Any Seepage or Efflorescence	Efflorescence noted at chamber walls of all four gates
Condition at Joints	Good
Condition of Discharge Channel	Not applicable; gates empty into main spillway discharge channel
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	Right bank of channel lined with rubble riprap
Trees Overhanging Channel	Right and left banks of channel grass and brush lined with some trees
Floor of Approach Channel	Submerged
Other Obstructions	It was reported by the Operator that an 8 in. water line was laid just U/S of the spillway
b. Weir and Training Walls	
General Condition of Concrete	Left U/S training wall in fair condition. Left D/S training wall covered under "power channel". Spillway weir was submerged at time of inspection. Composite brick and concrete foundation of abutting residential structure constitutes right D/S training wall and was in good condition

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Waverly Dam DATE: 6 Nov. 80

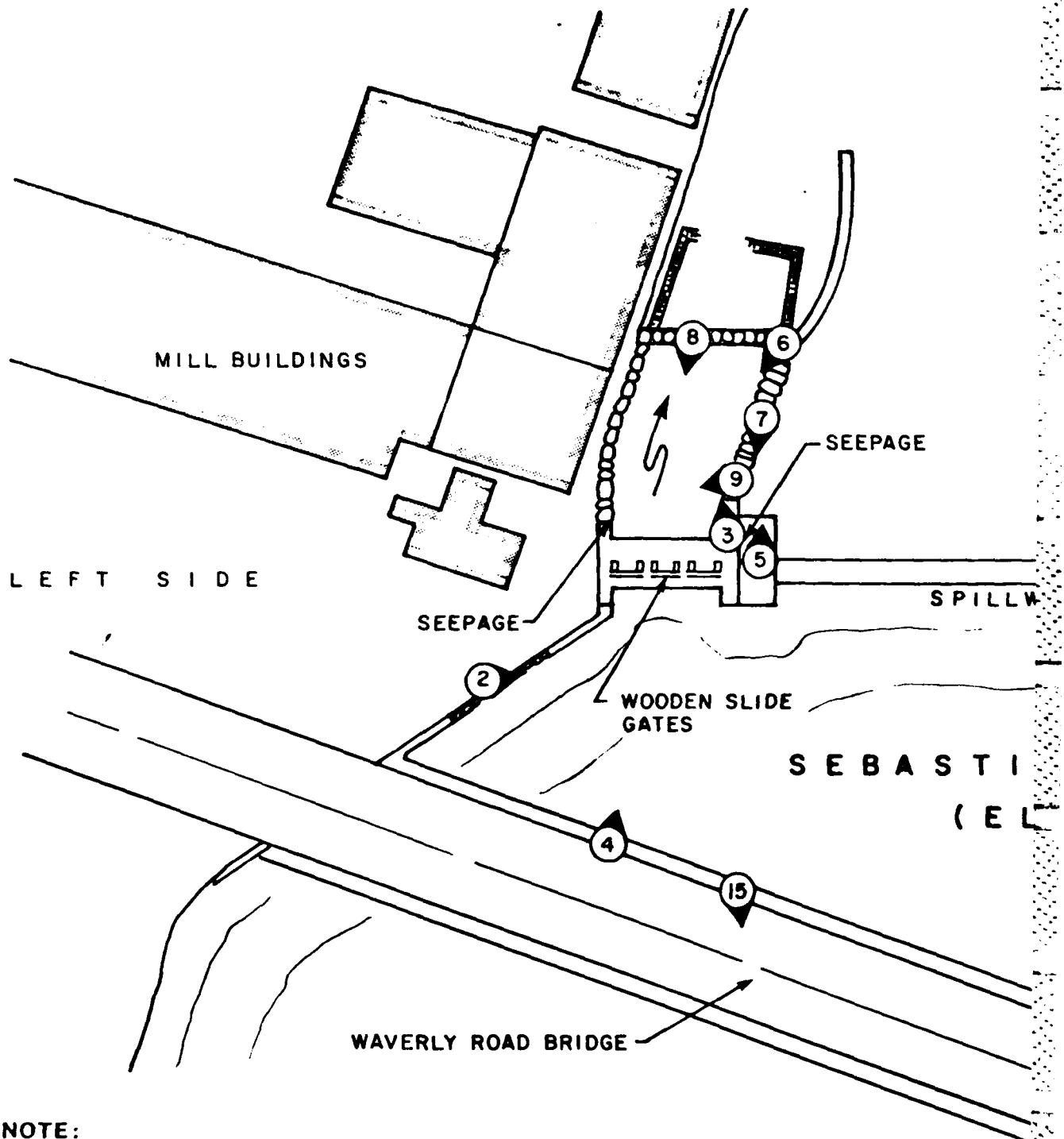
AREA EVALUATED	CONDITION
Rust or Staining	None noted
Spalling	At left training wall just U/S of forebay intake gates
Cracking	Major horizontal and vertical cracking noted at left U/S training wall
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	None observed
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Right bank of channel is tree lined. Mill Building on left bank
Floor of Channel	Submerged
Other Obstructions	Earth and stone rubble debris noted at right of channel D/S of outlet works

APPENDIX B - ENGINEERING DATA

LIST OF AVAILABLE DATA
WAVERLY DAM

Document	Contents	Location
Tax Atlases	Property and building descriptions previously used by the Town of Pittsfield for tax assessment purposes dated 1914	Town of Pittsfield P.O. Box R Pittsfield, Maine

APPENDIX C - PHOTOGRAPHS



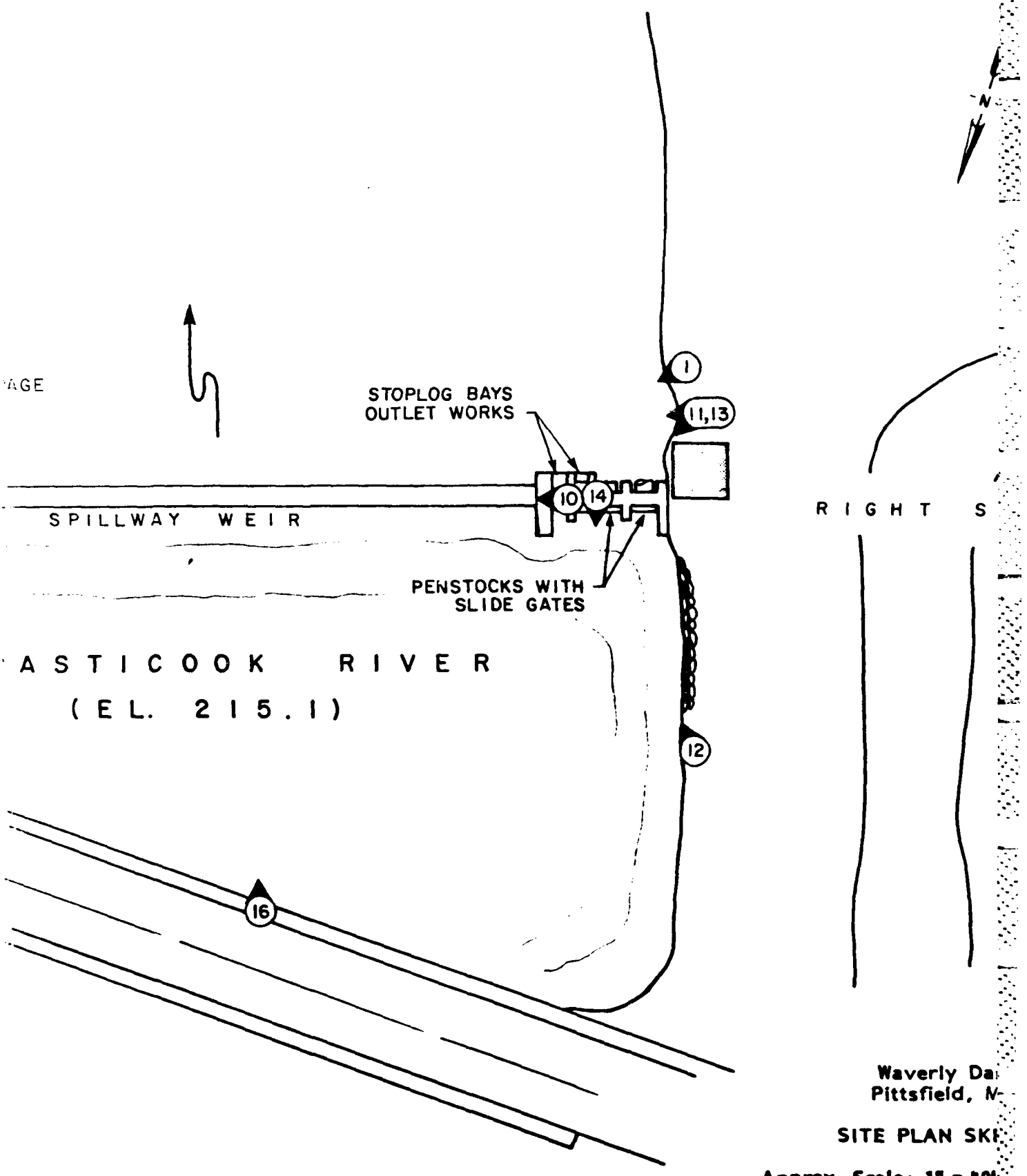
NOTE:

PLAN DEVELOPED FROM TOWN OF PITTSFIELD TAX ATLASES, DATED 1914, AND FIELD OBSERVATIONS MADE ON 6 NOVEMBER 1980.

LEGEND:

(2) **PHOTO NUMBER AND DIRECTION OF VIEW**

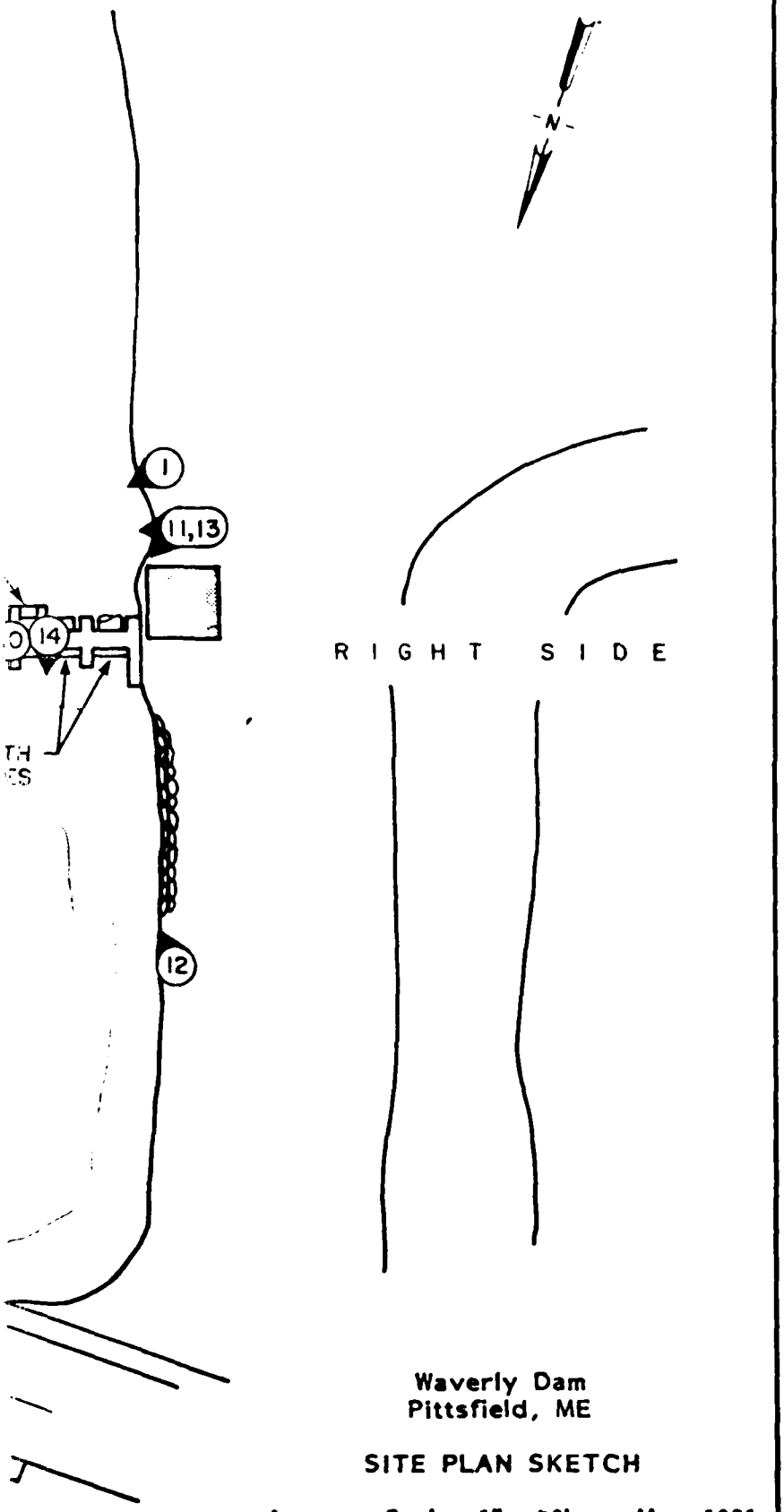
HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS



Waverly Da
Pittsfield, M

SITE PLAN SK

Approx. Scale: 1" = 40'



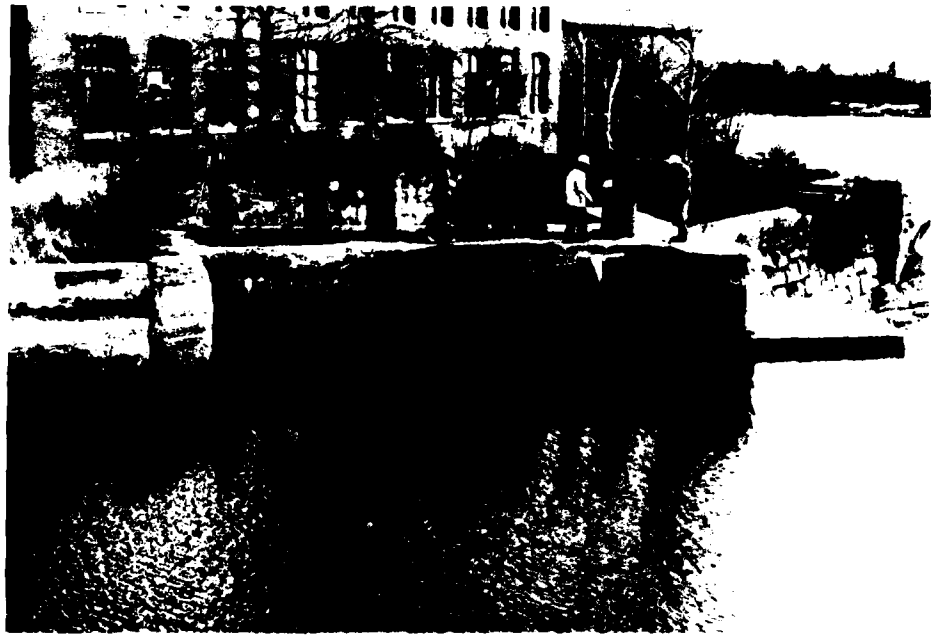
Waverly Dam
Pittsfield, ME

SITE PLAN SKETCH

Approx. Scale: 1" = 40' May 1981

2. Overview of Waverly Dam showing upstream side

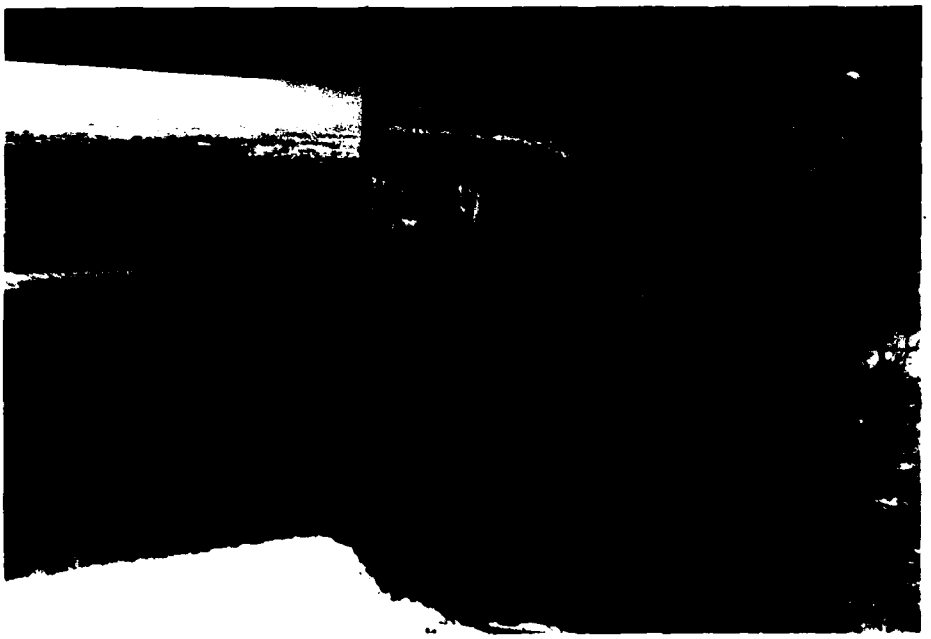
3. Interior and endwall of stone masonry forebay



4. Alignment at left end of dam, upstream

5. Vegetation in stone masonry and alignment of concrete training wall, downstream

6. Downstream side of intake structure at left end of dam



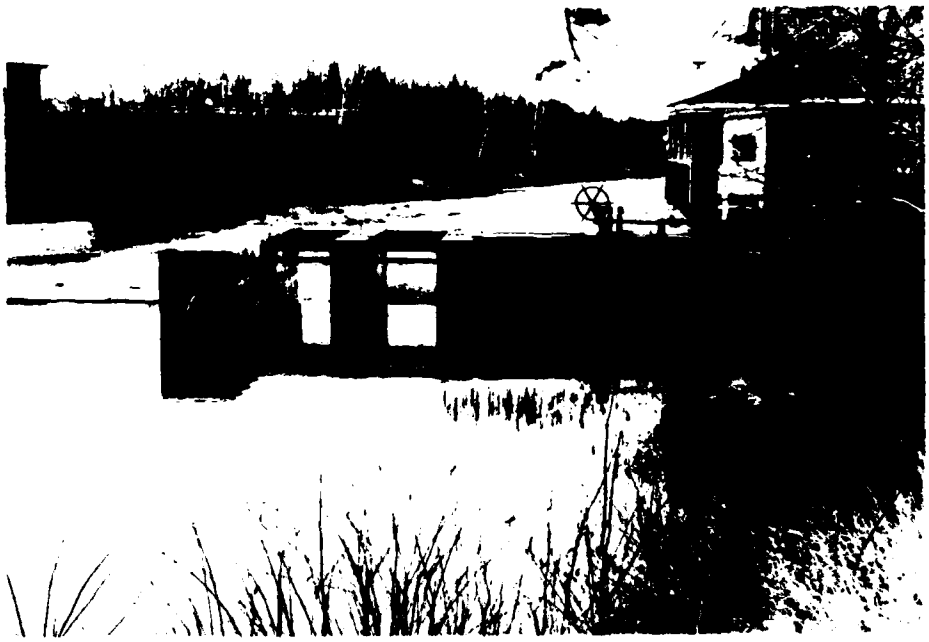
7. Downstream side of left spillway training wall

8. Interior of gate chambers at left end of dam

9. Location of seepage at left abutment, downstream

10. Longitudinal alignment of spillway

11. Horizontal alignment of spillway



12. Alignment at right end of dam

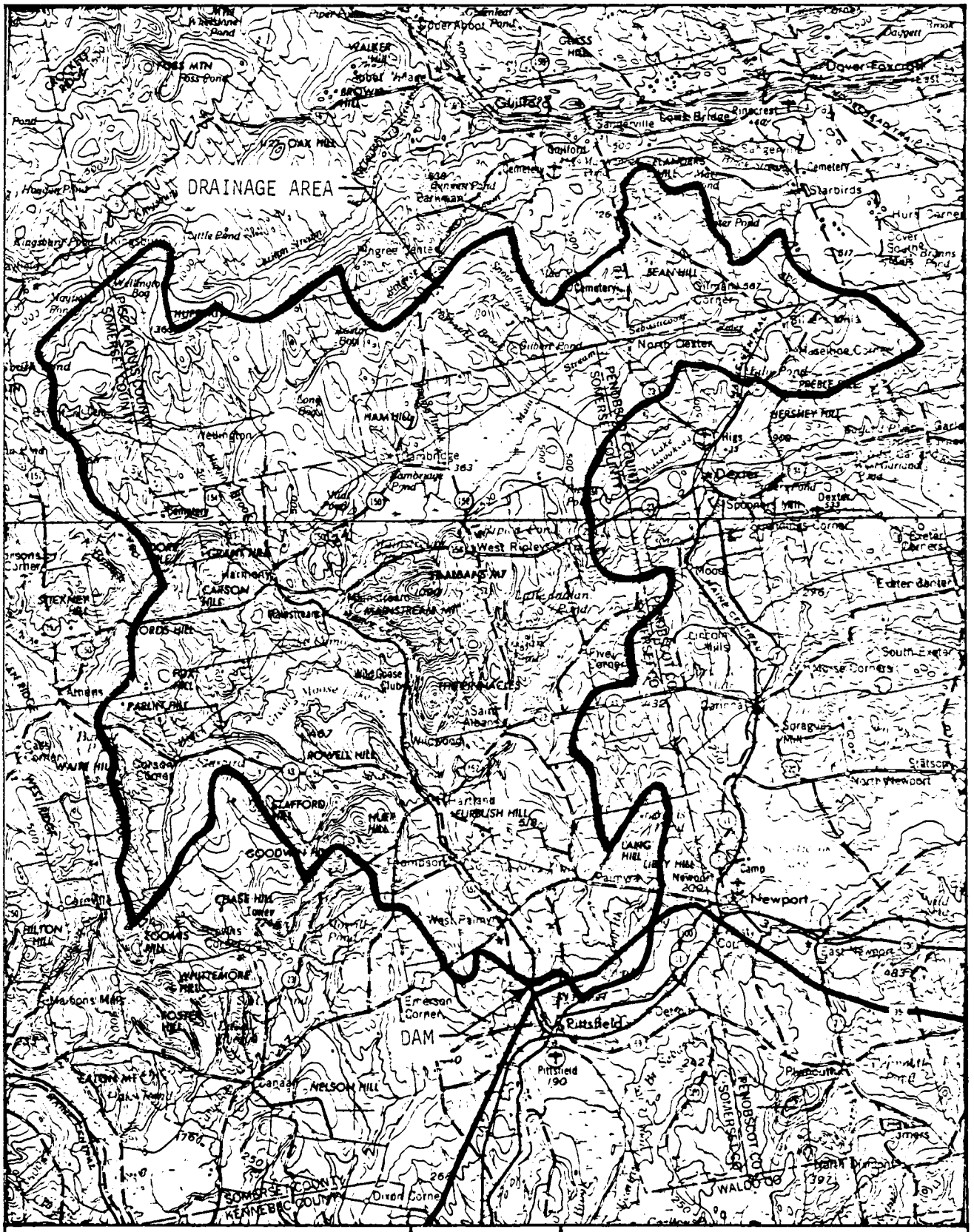
13. Downstream side of outlet works structure at right end of dam

14. Cracks in concrete training wall between stoplog bays at right end of dam, upstream

15. Upstream pool, Sabasticook River, from the Waverly Road bridge

16. Downstream channel, Sabasticook River, from the Waverly Road bridge

APPENDIX D - HYDRAULIC AND HYDROLOGIC COMPUTATIONS



UPPER WAVERLY DAM
ME 00111

DRAINAGE AREA MAP

APPROX. SCALE: 1" = 4 miles

ELEVATIONS

Spillway Crest Elev.	214.5	(Reported by owner)
Top of Dam Elev.	220.1	at right abutment
	221.3	at left abutment
Toe of Dam	200.0	est. from field measurements

Inv. of Outlets:

Left abut. -	207.3	3 wooden slide gates
Right abut. -	207.0	2 stop log bays
	209.0	2 wooden slide gates

FEATURES

Length of Spillway: ~195 ft. @ El. 214.5 and 8' @ El. 216.1
Length of Rt. conc. gate struct.: 41 ft. @ El. 220.1
Length of Lt. conc. gate struct.: 32 ft. @ El. 221.3

Gated Outlets:

Left Abut. - 3 gate, each 3.75'W x 6'H
Right Abut - 2 stop log bays, each 5'W and 2 gates, each 8'W.

SURFACE AREAS

Drainage Area ~ 290 sq. mi.

W.S. Area @ El. 214.5 ≃ 560 acres

Area of 220' contour ≃ 990 acres

Assume linear relationship above El. 220.

STORAGE CAPACITIES

At spillway crest (El. 214.5) = 560 acres x 5' avg. depth = 2,800 ac-ft.

At top of dam (El. 220.1) = 2800 + (560+990)/2 x 5.6' = 7,140 ac-ft

SIZE CLASSIFICATION

Hydraulic Height ≃ 20 ft. and storage at top of dam is 7,140 ac-ft.

∴ Size is INTERMEDIATE

HAZARD CLASSIFICATION

Based on the dam failure analysis, the potential loss of life would be a few and the Hazard Classification is SIGNIFICANT

TEST FLOOD DETERMINATION

For an Intermediate size dam with a Significant hazard classification, Corps of Eng'rs Guidelines give a test flood range of 1/2 PMF to a full PMF. (Probable Maximum Flood). Adopt 1/2 PMF as test flood.

Prior analysis of the Lower Pioneer Dam estimated the 1/2 PMF flow for the 290 sq. mi. drainage area to be 15,000 cfs. This estimate was based on detailed analysis by the Corps of Engineers of the 235 sq. mi. watershed U/S of Waverly dam which is regulated by Great Moose Lake with allowance for the intervening Drainage area.

∴ Test Flood outflow at Waverly dam = 15,000 cfs.

STAGE-DISCHARGE RELATIONSHIPS

Spillway discharge: $Q_s(cfs) = C_1 L_1 H_1^{3/2} + C_2 L_2 H_2^{3/2}$

where C_1 varies with H_1
$L_1 = 195$ ft.
H_1 = W.S. − 214.5
$C_2 = 3.2$
$L_2 = 8$ ft.
H_2 = W.S. − 216.1

Flow over top of dam: $Q_D(cfs) = C_R L_R H_R^{3/2} + C_L L_L H_L^{3/2}$

Where Right Abut.: $C_R = 2.6$
$L_R \approx 100$ ft.
H_R = W.S. − 220.1

Left Abut.: $C_L = 2.8$
$L_L \approx 120$ ft.
H_L = W.S. − 221.3

W.S. ELEV.	SPILLWAY		DAM OVERTOPPING		TOTAL (cfs)
	C_1	Q_s (cfs)	RT. ABUT. $Q_{R.A.}$ (cfs)	LT. ABUT. $Q_{L.A.}$ (cfs)	
214.5	-	0	-	-	0
216.1	3.1	1,220	-	-	1,220
218.0	3.45	4,470	-	-	4,470
219.0	3.55	6,730	-	-	6,730
220.1	3.65	9,640	0	-	9,640
221.3	3.7	13,100	340	0	13,440
221.5	3.7	13,680	430	30	14,140
221.7	3.7	14,280	530	90	14,900
222.0	3.7	15,190	680	200	16,070

∴ Test Flood stage for outflow ≈ 15,000 cfs is El. 221.7

TAILWATER ANALYSIS

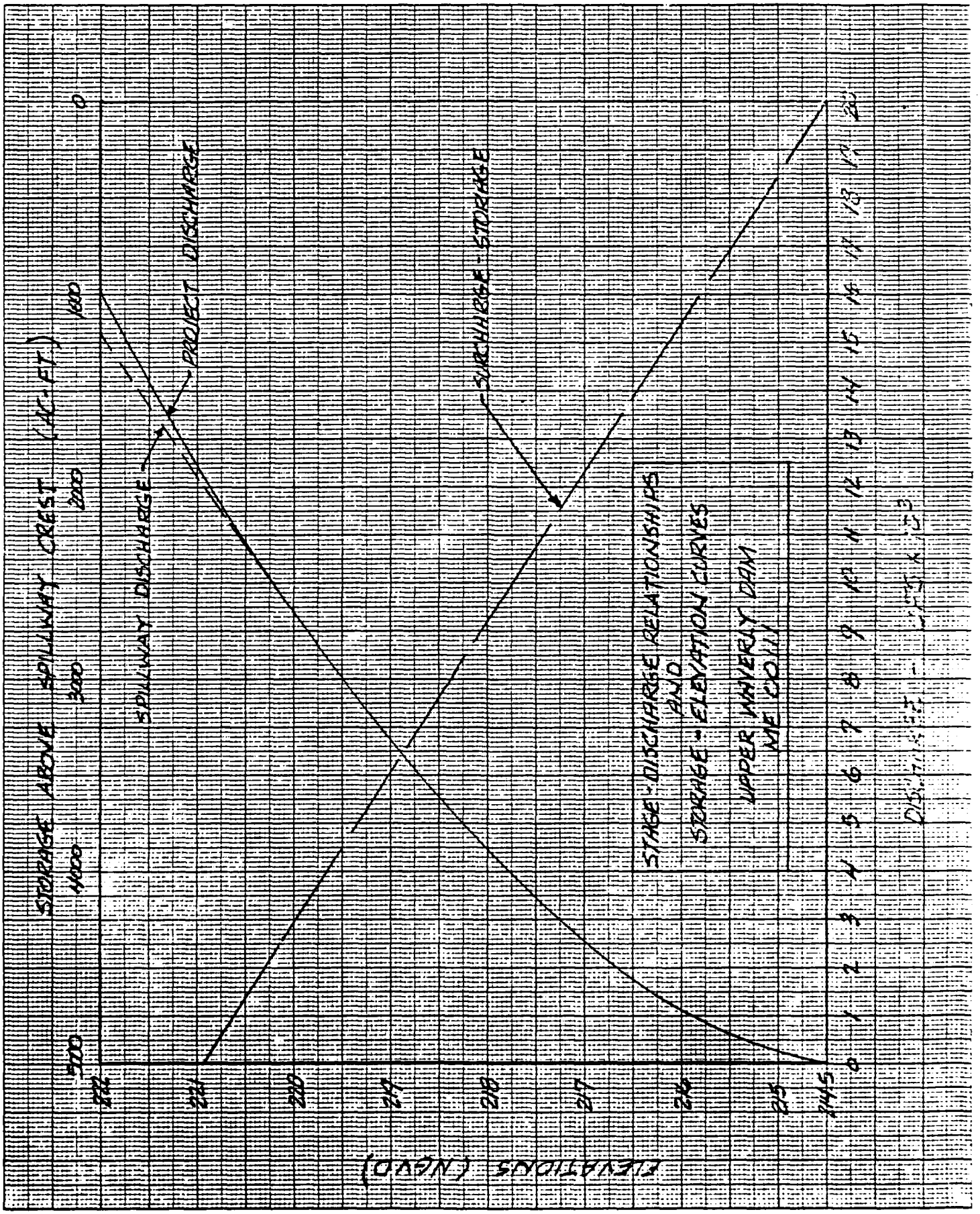
Avg. width of d/s channel = 250'
Avg. slope from toe of dam = 0.002
Avg. "n" = 0.05

$$\therefore Q = \frac{1.49}{0.05} A R^{2/3} (.002)^{1/2} = 1.333 A R^{2/3}$$

where $A = 250 \times y$
$R = 250 \times y / 250 + 2y$
y = depth of flow

Depth y (ft.)	A (ft.^{2})	R	Q (cfs)
5.0	1250	4.81	4,750
7.5	1875	7.08	9,220
10.0	2500	9.26	14,680

∴ Pond @ top of dam (El. 220.1), Q = 9,640 cfs & tailwater elev. ~ 207.5
Pond @ El. 221.7, Q ≈ 15,000 cfs & tailwater elev. ~ 210.0


STAGE-DISCHARGE RELATIONSHIPS
AND
STORAGE-ELEVATION CURVES
UPPER WATERY DAM
ME 00111
ELEVATIONS (NGVD)
STORAGE ABOVE SPILLWAY CREST (AC-FT)
SPILLWAY DISCHARGE
PROJECT DISCHARGE
SURCHARGE-STORAGE

OUTLET WORKS

Spillway Left Abutment:

A. 3 wooden slide gates leading to abandoned power canal. With gates opened, flow would pass beneath concrete bridge through two 8.7'φ steel culverts and into d/s channel.

Size: 3.75' wide × 8' high, each
Inv. El. 207.3

$Q = CA(2gh)^{1/2}$ where $C = 0.6$
$A = 3.75 \times 8 \times 3 = 90 ft.^2$
$h = W.S. - (207.3 + 4)$

With pond level at top of dam (El. 220.1)

$Q = 0.6 \times 90 \times (32.2 \times 8.8)^{1/2} \simeq 900$ cfs

Spillway Right Abutment:

B. 2 wooden slide gates each outleting to short sections of 6'φ penstocks which discharge directly to d/s channel. Reportedly, these penstocks once extended to power generating equipment in the basement of what is now a residential house on the spillway right abutment.

Size: 8' wide × 8.25 ft. high, each leading to 6'φ steel penstocks
Inv. El. 209.0

$Q = CA(2gh)^{1/2}$, $C = 0.6$, Area of penstocks $= \pi R^2 \times 2$
$= \pi (3)^2 \times 2 = 56.5 ft^2$
$h = W.S. - (209 + 3)$

for W.S. El. 220.1, $Q = 0.6 \times 56.5 \times (32.2 \times 8.1)^{1/2} = 550$ cfs

C. 2 stop log bays assumed to be outlet works

Size: 5' wide × 8.25' high
Inv. El. 207.0

Estimate discharge capacity with pond at spillway crest

$Q = CLH^{3/2} = 2.5 \times (5 \times 2) \times (214.5 - 207)^{3/2} \simeq 500$ cfs

DAM FAILURE ANALYSIS

Assume 40% of spillway crest length fails,

then $Q_{P_1} = 8/27 \times (195' \times 0.4) \times (32.2)^{1/2} (20.1)^{3/2} \simeq 11,800$ cfs

Spillway discharge prior to failure:

$$Q_S = 3.65 \times 195 \times (5.6)^{3/2} + 3.2 \times 8 \times (4)^{3/2} = 9430 + 210 = 9,640 \text{ cfs}$$

Combined flow at failure = $9640 \times .6 + 11,800 \simeq 17,500$ cfs

Existing development which might be affected includes structures at both the abutments of the dam as well as at Main St. approx. 3000 ft. d/s of dam.

The right abutment incorporates a residential home which has a first floor elev. above the top of dam. While this structure could experience some basement flooding due to a full spillway discharge of ~ 9,600 cfs, there would not appear to be any threat of loss of life.

Failure of the dam could affect the structural stability of the house at the right abutment and there represents the potential loss of a few lives.

The existing mill complex located to the left of the dam and extending d/s along the left bank of the Sebasticook River would be flooded by a full spillway discharge of ~9,600 cfs. Failure of the dam would not structurally effect the mill complex and the increased flooding due to failure is not expected to increase the potential for loss of life.

Prior analysis of the Lower Pioneer Dam located about 3500 ft. d/s of the Upper Waverly dam determined that the headwater elev. for a flow of 9,600 cfs would be about at the sill elevations of several homes and business. A failure outflow of 17,500 cfs would increase flood stages around Main St. by about 2.5 ft. which would increase property damages but would not significantly increase the potential for additional loss of life.

∴ Hazard classification is SIGNIFICANT

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

DTIC